GROWTH OF SPRING CEREALS in Northwestern Canada and Alaska

CANADA DEPARTMENT OF AGRICULTURE AND UNIVERSITY OF ALASKA

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EARLY VARIETIES GROW WELL

Where there is local demand for spring wheat, oats or barley, early-maturing varieties can be grown profitably in many localities in northern Alberta, the Northwest and Yukon territories, and Alaska.

Growth at six test sites was affected by day length, temperature and rainfall during the growing season and presumably by fertility and tilth of the soil. Day length and winter precipitation were the only factors in the environment associated with latitude.

Because of variations in rainfall and temperature, at each site the annual differences in crop growth and yield were often greater than the average differences between sites. Improvements in culture are likely to increase and stabilize growth and yield in all localities, particularly at Fort Vermilion, Fort Simpson and Mile 1019, where soil amendments were not used.

More suitable varieties can also be developed. For each crop, breeding programs promise to provide varieties that are more productive in most localities in the north. To stabilize production, these varieties will have to be very widely adapted.

Cover photograph: A field of Abegweit oats at Mile 1019.

Growth of Spring Cereals in Northwestern Canada and Alaska

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Cereal, forage and horticultural crops grow well in northern Alberta, the Yukon and Northwest territories, and Alaska (4–7, 13) and there are large areas of land suitable for these crops (8). This is a report on the growth and yield of selected varieties of wheat, oats and barley tested from 1952 to 1959 at six sites extending from Beaverlodge, Alberta, northwest to Fairbanks, Alaska.

In Canada, tests were conducted on the experimental farms at Beaverlodge, Alberta, in the southwestern part of the Peace River region; at Fort Vermilion, Alberta, in the northern part; in the Takhini-Dezadeash Valley at Mile 1019 on the Alaska Highway, Yukon Territory; and at Fort Simpson, Northwest Territories, on an island at the junction of the Liard and the Mackenzie rivers.

In Alaska, they were conducted on the Matanuska Agricultural Experiment Station farm near Palmer and on the College Agricultural Experiment Station farm near Fairbanks.

The geographical locations are shown in Figure 1, and the longitude, latitude, elevation, soil characteristics and cultivated acreage in each region in Table 1.

CLIMATE

Records were taken at each site on precipitation and temperature during the growing season, and dates of the last frost and the last killing frost in the spring and the first in the fall. Day length was calculated (12). These factors determine whether or not crops can be grown in the north where there is suitable soil.

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TABLE 1. – Geographical and soil characteristics of the test sites

Station	Latitude N.	Longitude W.	Feet above sea level	Soil classification and characteristics						Cultivated acreage in region (all soils)
				Great group or subgroup	Series	Orgin of parent material	Surface texture	Subsoil texture	pH	
Beaverlodge (11)[1]	55° 12′	119° 27′	2400	Dark Gray Solod	Esher	Lacustro-till	Loam	Clay loam	5.6	3,200,000
Fort Vermilion[2]	58° 18′	116° 00′	900	Dark Gray Wooded	—	Lacustrine sediment	Fine sandy loam	Clay loam	6.9	70,000
Mile 1019 (2)	60° 45′	137° 35′	2000	Orthic Re-gosol	Pine Creek	Lacustrine sediment	Silty clay	Silty clay	7.0	1,200
Fort Simpson (3)	61° 52′	121° 52′	400	Organo Regosol	Liard	Alluvium	Loam	Loam	7.6	150
Palmer (10)	61° 34′	149° 16′	150	Orthic Regosol	Knik	Loess	Silt loam	Silt loam	6.0–6.5	17,000
Fairbanks (10)	64° 51′	147° 52′	620	Subarctic Brown Forest	Fairbanks	Micaceous loess	Silt loam	Silt loam	6.1	5,300

[1]Each reference is to a publication on the soil type.

[2]The soil is described in detail in an unpublished report, "Soil Report on the Experimental Substation, Fort Vermilion, Alberta," by T. W. Peters, Canada Department of Agriculture, Alberta Soil Survey, University of Alberta, Edmonton.

Figure 1. Locations of the six test sites.

Day Length

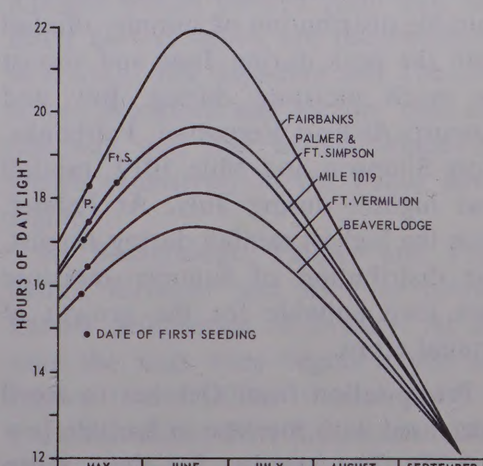
Daylight on June 21 ranged from 17.5 hours at Beaverlodge to 22.0 hours at Fairbanks (Figure 2). These photoperiods, which are longer than in the south, are thought to be responsible for the more rapid development and maturation of plants in the north (1, 9).

Except at Fort Simpson, seeding commenced near May 10 on the average and the crops developed under day lengths that were different only because of latitude. At Fort Simpson seeding began an average of 10 days later, and crops commenced development under day lengths similar to those at Fairbanks, which is three degrees farther north.

Precipitation

The mean annual precipitation from 1952 to 1959 ranged from 17.1 inches at Beaverlodge to 11.3 inches at Mile 1019. At all test sites there were large annual variations in monthly precipitation, particularly during June, July and August (Figure 3). These variations occurred at random, with no relationship between one month and the next, and in the main must account for the large annual fluctuations in yield and other agronomic characteristics at each site.

Figure 2. Hours of daylight at the six sites during May to September (12), and average dates of first seeding.



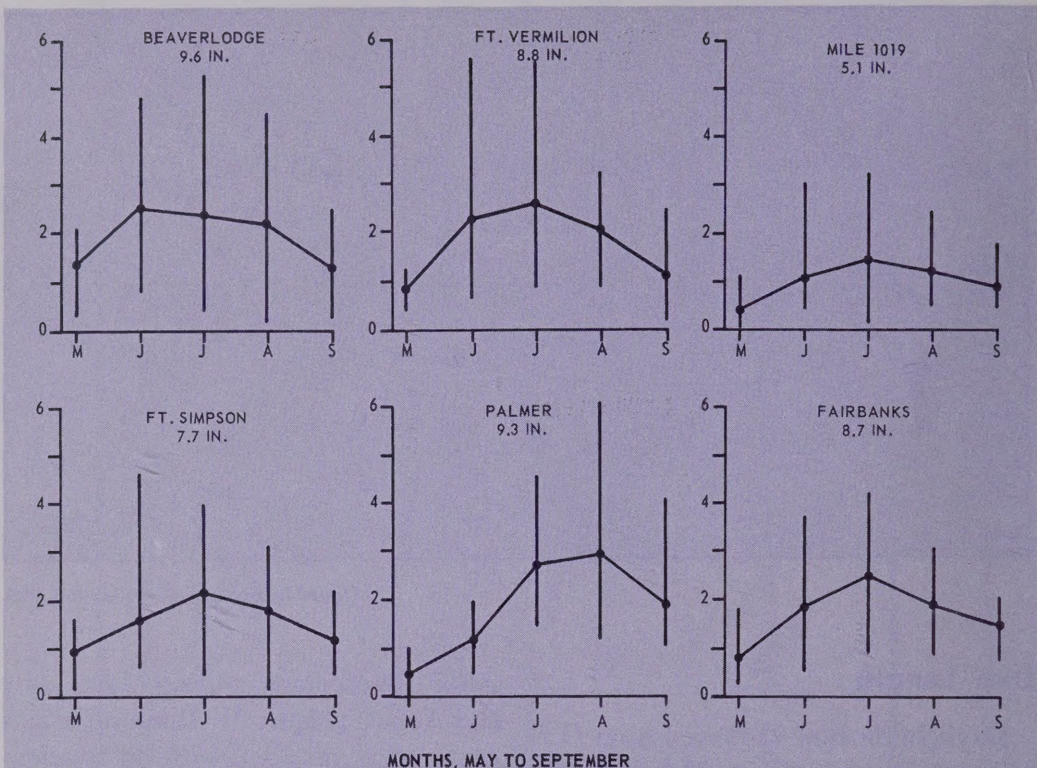


Figure 3. Averages and ranges of monthly precipitation at the test sites for May to September. The total for the five months is given under the name of each site.

Beaverlodge and Palmer had the highest average precipitation for May to September (9.6 and 9.3 inches), followed by Fort Vermilion, Fairbanks, Fort Simpson and Mile 1019 with 8.8 to 5.1 inches. Beaverlodge had the most suitable distribution of summer rainfall with the peak during June and almost as much moisture during July and August. At Fort Vermilion, Fairbanks, Fort Simpson and Mile 1019, rainfall was highest during July. At Palmer, with the highest rainfall during August, the distribution of summer moisture was least suitable for the growth of annual crops.

Precipitation from October to April decreased with increase in latitude ($r = -0.95$). The average for these seven months at Beaverlodge was 7.5 inches; at Fort Vermilion, 6.2; at Mile 1019, 6.2; at Fort Simpson, 5.3; at Palmer, 5.5; and at Fairbanks, 3.5. Much of this precipitation comes in the form of snow that runs off during the spring thaw and provides little moisture for the growing crop.

Temperature

Most outstanding were the very low temperatures at Mile 1019; for example, the monthly mean for July was only 53.8° F compared with 58.1 to 62.8° at the other sites (Figure 4). These low temperatures are caused by cooling of the prevailing winds as they pass over

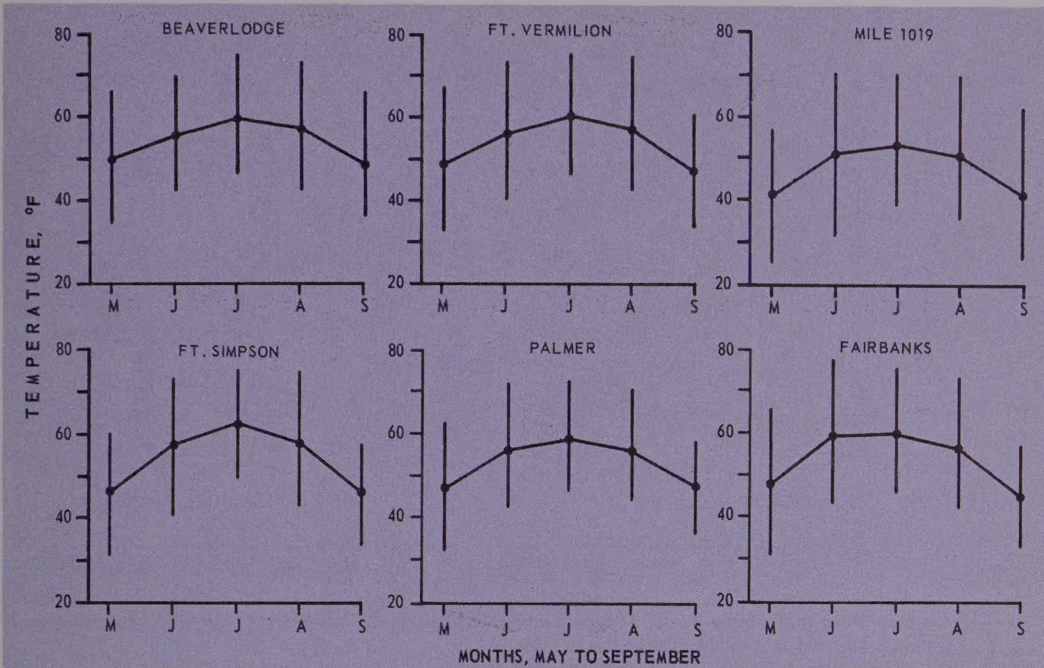


Figure 4. Average monthly temperatures at the test sites for May to September, and ranges from the highest mean maximum to the lowest mean minimum, 1952 to 1959.

the St. Elias glacial field to the southwest of Mile 1019 (7). Of the other sites, Beaverlodge consistently had the highest May and September temperatures. These differences were offset by slightly higher temperatures during June, July and August at Fort Simpson and during June and July at Fairbanks.

Growing Period

The average growing period (basis 28° F) ranged from 140 days at Beaverlodge to 54 days at Mile 1019 (Figure 5). These differences were caused by both later-spring and earlier-fall frosts. Dates of seeding and of the first killing frost in the fall varied considerably from year to year, but the early-maturing varieties of all crops usually matured normally at all sites. Wheat was often frozen at Mile 1019.

CROP GROWTH

The performances of three varieties were averaged as a measure of the growth of each crop. The varieties were: Khogot wheat, Golden Rain oats and Edda barley, which are recommended in Alaska; and Saunders and Thatcher wheat, Abegweit and Victory oats and Gateway and Olli barley, which are grown extensively in the Peace River region.

At Beaverlodge, Palmer and Fairbanks, fertilizer was used to correct known deficiencies in fertility. At the time the tests were begun it was not known that fertilizer was required at Fort Vermilion, Fort Simpson or Mile 1019, and none was used at these sites.

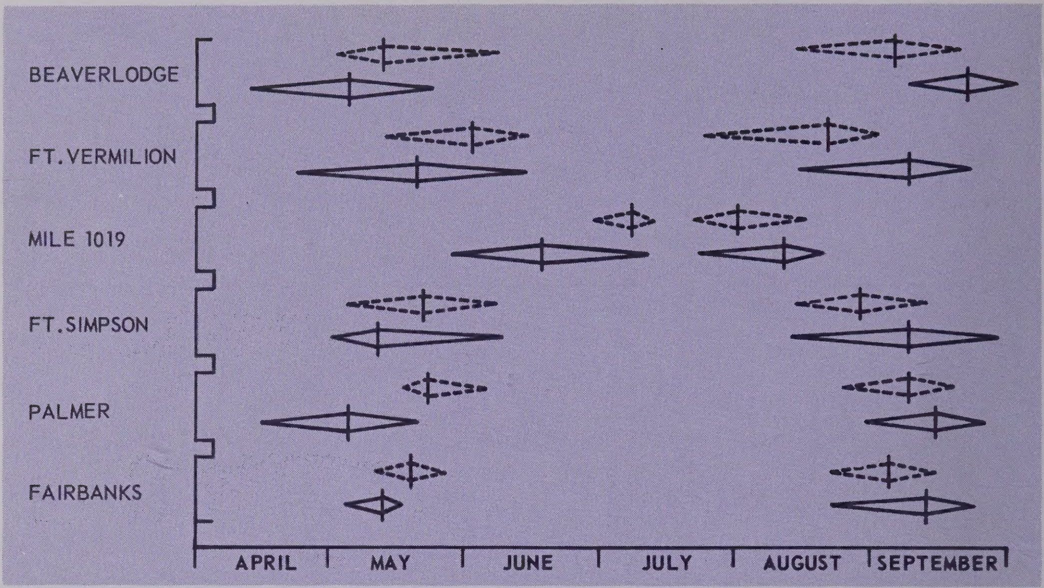


Figure 5. Average dates and ranges for last frost (broken lines) and last killing frost (basis 28° F; solid lines) in the spring and first in the fall at the test sites.

Maturation

There were large differences between test sites in the time required for each crop to ripen (Figure 6). Wheat and oats required longer to ripen at Beaverlodge than at the other Canadian sites. These differences appear to be related to the acceleration in development normally associated with increase in day length. However, if day length were the main influence, the maturation of barley would not have been delayed at Mile 1019, there would have been more rapid development at Palmer and Fairbanks and the annual differences in maturation at all sites would have been much less.

The much more rapid development at Fort Simpson than at Beaverlodge was caused by the longer days, later seeding, higher temperatures during June and July and lower rainfall. The more rapid development at Fort Vermilion than at Beaverlodge may have been due in part to the light, sandy soil warming up more rapidly in the spring and maintaining a higher temperature. The rather long period required for development at Mile 1019 was obviously due to low temperature and probably would have been longer were it not for the low rainfall. Despite the longer days at the higher latitude, development in Alaska was about the same as at Beaverlodge. We assume that development was delayed at both sites by the application of nitrogen and at Palmer by the unfavorable distribution of rainfall and the cloudy maritime environment.

Kernel Development

The seed produced was usually viable (Figure 6). Even at Mile 1019, with an average growing period of only 54 days, when wheat did not mature properly its ability to germinate was only moder-

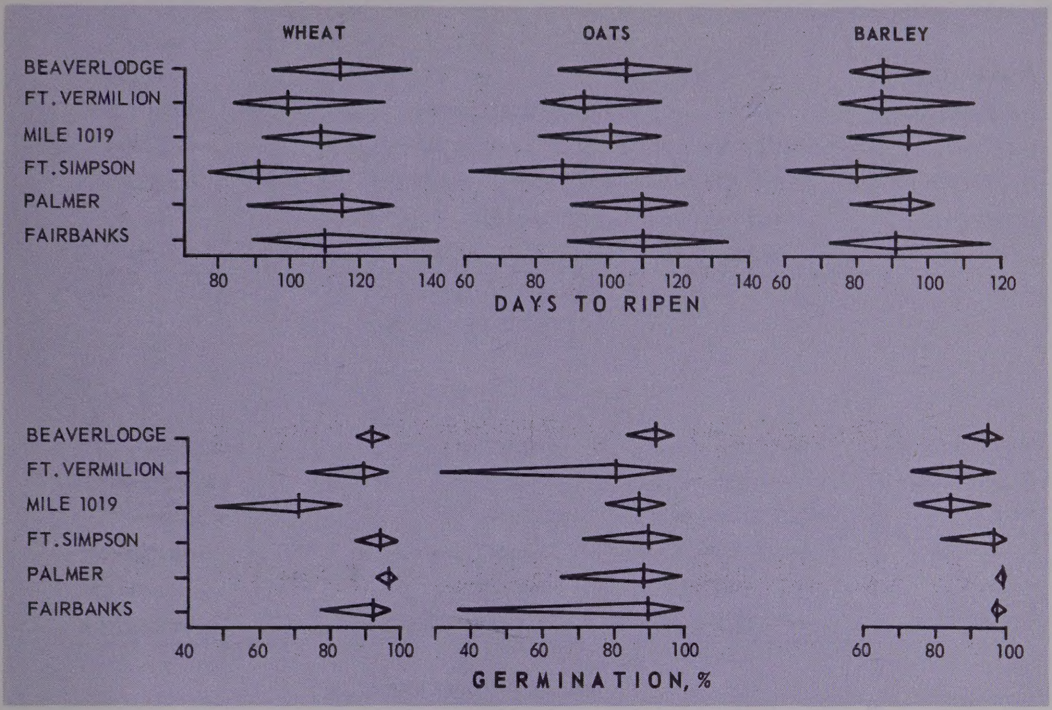


Figure 6. Means and ranges for days required to ripen wheat, oats and barley at the test sites, and for percentages of germination.

ately reduced. Oats and barley escaped damage at Mile 1019 except in 1959. The ability of oats to germinate was reduced to 31 percent at Fort Vermilion in 1957 and to 36 percent at Fairbanks in 1952. This was attributed to light frost during the early stages of kernel development.

The bushel weight of barley was low only at Fort Vermilion and that of oats only at Fort Vermilion and Palmer (Figure 7). The bushel weights for wheat were slightly low and varied considerably at all sites except Beaverlodge and Fort Simpson. The consistently more favorable bushel weights of barley emphasize the advantage of its earlier maturation.

There was a general tendency for 1000-kernel weights to increase with increase in latitude (Figure 7). This trend may reflect an increase in the rate of net assimilation with increase in day length but may also have been caused by the development of fewer kernels per spike (9). The trend was most noticeable for barley and least for wheat.

Yield

Beaverlodge had the highest yields of all crops and Palmer the next highest (Figure 8). For barley, Fort Vermilion and Fort Simpson were in third place and Mile 1019 and Fairbanks had the lowest yields. For oats, Fort Simpson and Fairbanks were in third position and Fort Vermilion and Mile 1019 at the bottom. For wheat, Fort Vermilion was third in order of yield, Fort Simpson

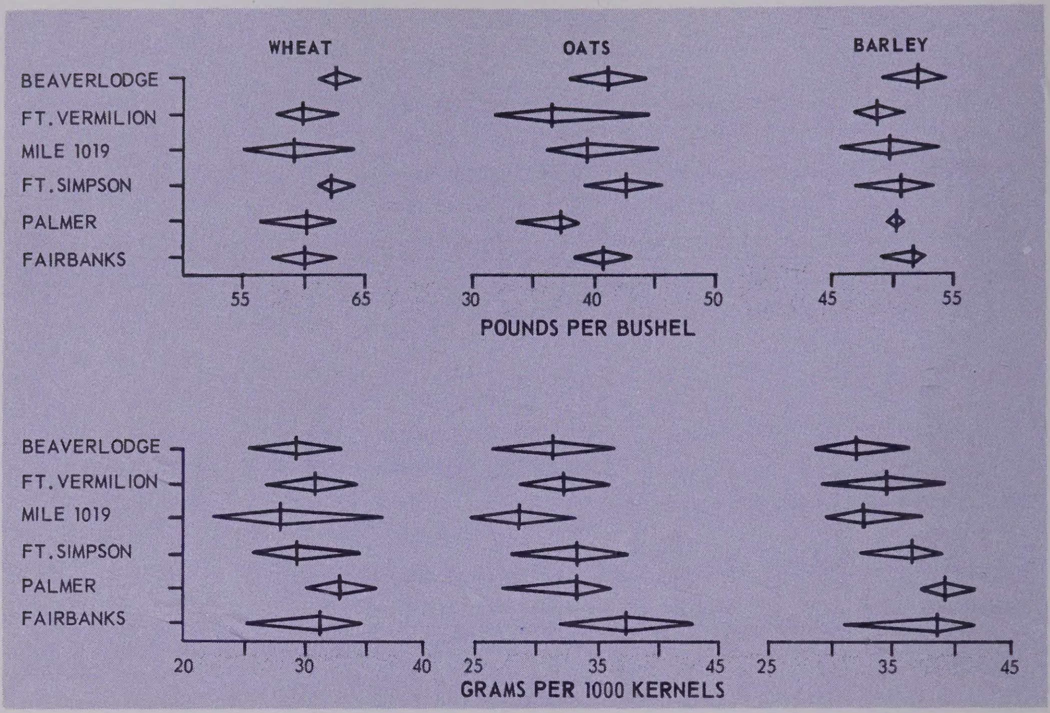
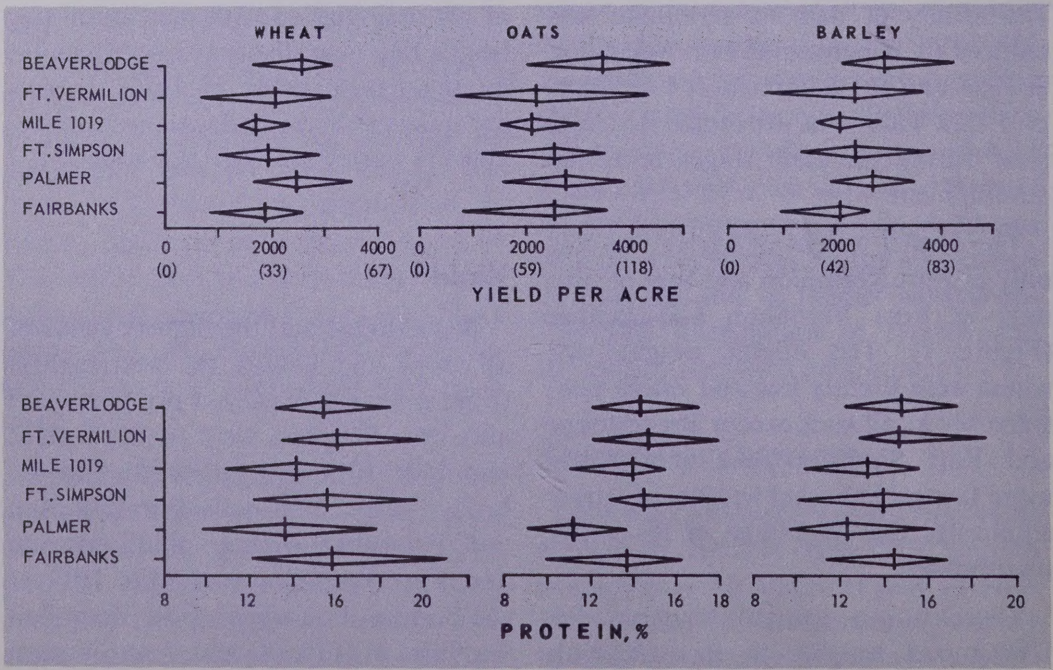


Figure 7. Means and ranges for weight per bushel of wheat, oats and barley at the test sites, and for weight; per 1000 kernels.

Figure 8. Means and ranges for yields in pounds and bushels (in parentheses) per acre for wheat, oats and barley at the test sites and for percentage protein.



and Fairbanks were fourth and Mile 1019 was last. For all crops, Beaverlodge averaged 68 bushels per acre; Palmer, 59; Fort Simpson, 52; Fort Vermilion and Fairbanks, 49; and Mile 1019, 44.

Because of annual differences in precipitation, temperature and other climatic factors, at each site the annual variations in yield were larger than those between sites. For example, though Mile 1019 had the lowest mean yields, three of the other test sites had lower yields during at least one of the eight years. However, in no year did any of the localities produce less than 11 bushels of wheat per acre, 14 of barley or 20 of oats.

Protein Content

Differences between test sites in mean percentage protein of the grain were usually moderate and annual variations in percentage protein were large (Figure 8). Protein content was low for all crops at Palmer and for wheat and barley at Mile 1019. At all other sites it appears to have been satisfactory.

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